Circulation

CASES AND TRACES

# Cardiac Arrest With ST-Segment–Elevation in V1 and V2

## Differential Diagnosis

Belén Arroyo Rivera, MD
Álvaro Aceña, MD, PhD
Pepa Sánchez-Borque, MD
Miguel Orejas, MD, PhD
Jose Tuñón, MD, PhD

## ECG CHALLENGE

A 58-year-old male patient arrived at the emergency department following out-of-hospital cardiac arrest. He had no known cardiovascular risk factors other than smoking. His relatives reported that he had developed oppressive retrosternal chest pain and sweating 3 hours prior to presentation. The first documented rhythm was ventricular fibrillation, requiring 4 electric shocks to restore sinus rhythm and return of spontaneous circulation. The postresuscitation ECG is shown in Figure 1. What is the most likely diagnosis?

Please turn the page to read the diagnosis.

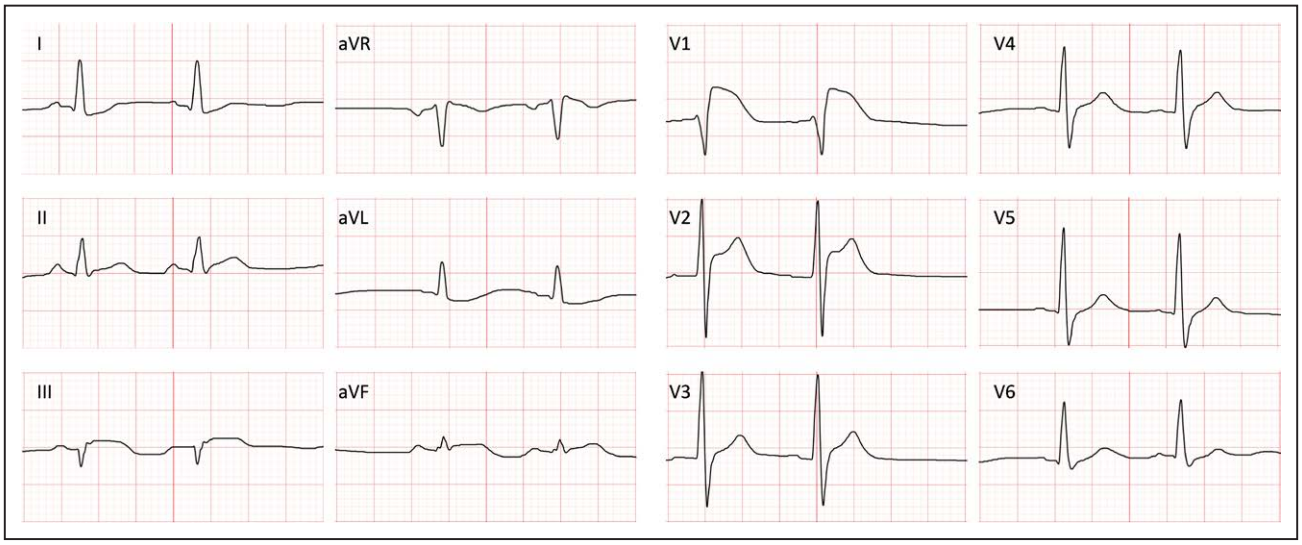


**Figure 1. The 12-lead ECG at the emergency room.**
The 12-lead ECG at the emergency room, showing ST-segment–elevation in lead V1 and V2.







*Circulation.* 2018;137:1742–1744. DOI: 10.1161/CIRCULATIONAHA.118.033778

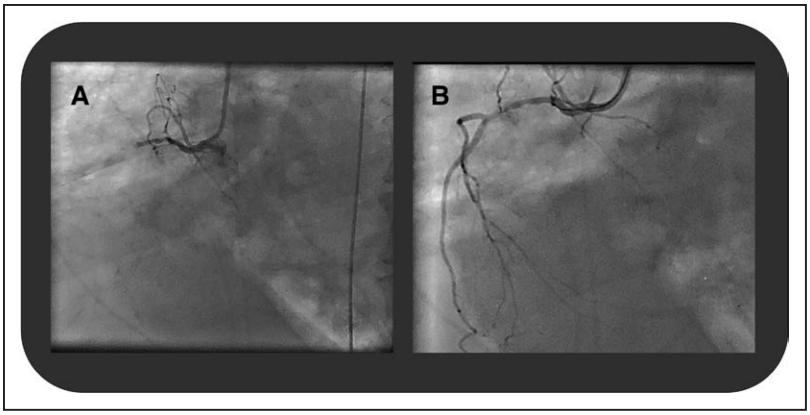


**Figure 2. Coronary angiography before and after conventional percutaneous coronary intervention.**
**A**, Coronary angiography showing a total occlusion of the right coronary artery. **B**, Coronary angiography after conventional percutaneous coronary intervention.

## RESPONSE TO ECG CHALLENGE

The ECG revealed sinus rhythm, narrow QRS complex, ST-segment–elevation in lead V1 and V2, with a slight elevation in leads III and aVF and 1-mm ST-segment–depression in leads I and aVL. Surprisingly, no pathological Q waves were evidenced after more than 3 hours of chest pain.

These findings, which include predominant ST-segment–elevation in V1-V2, initially suggested ischemia in the left anterior descending artery area, proximal to the first septal and the first diagonal branches. However, such occlusions typically would show ST-elevation in aVR and ST-segment–depression in the inferior leads, unless it was mid to distal left anterior descending artery occlusion that supplied part of the inferior wall. We also would not expect ST-segment–depression in lateral leads nor a tall R wave in V2, as in our case. On the other hand, the slight ST-segment–elevation in III and aVF is compatible with acute inferior myocardial infarction.[1] In that case, the ST-segment–elevation in V1-V2 could be explained by right ventricular involvement.

An alternative differential diagnosis includes ventricular fibrillation in a patient with Brugada syndrome, as the coved-type J-point elevation in V1-V2 resembles a type-1 Brugada pattern. However, some circumstances, including acute ischemia, can induce a Brugada type pattern that disappears on resolution of the injury (named Brugada phenocopies).[2] For this reason, it is important to rule out other causes for the ECG findings before making the diagnosis of Brugada syndrome. If that was the case, we would not expect to find other ST-segment alterations such as those observed in inferior or lateral leads, and, moreover, we would expect inverted T waves in V1-V2 to fulfill the diagnostic criteria.

An emergent coronary angiogram was performed (Figure 2) showing total occlusion of a nondominant right coronary artery at its proximal segment, before the takeoff of a right ventricle marginal branch. A balloon angioplasty was performed revealing a small-caliber distal vessel (<1.5 mm), so it was decided not to stent. There were no significant lesions in the other coronary arteries.

A cardiac magnetic resonance imaging (Figure 3) confirmed the presence of an isolated right ventricular myocardial infarction, with a dilated right ventricle (transmural retention of gadolinium in relation to necrosis and akinesia of its lateral wall). No pathological alterations were observed in the left ventricle.

Changes in ECG are shown in Figure 4, with T wave inversion from V1 to V4. These findings can be observed in situations that cause right ventricular overload.

It is important to recognize right ventricular myocardial infarction on the ECG, as clinical management

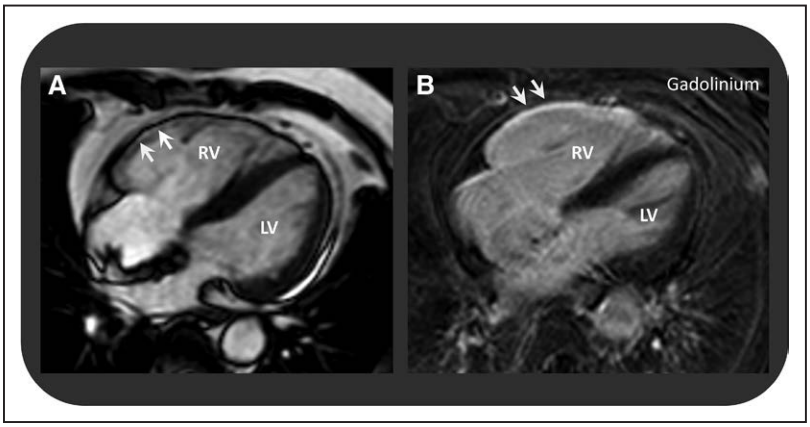


**Figure 3. Cardiac magnetic resonance imaging (MRI).**
**A**, Cardiac MRI (CINE MR, static image) showing a dilated right ventricle (**arrows**), with extensive free-wall akinesia. **B**, Cardiac MRI sequence of late gadolinium enhancement in which we can observe extensive transmural retention of contrast (**arrows**), compatible with RV infarction (isquemic necrosis). No pathological gadolinium retentions were observed in the left ventricle. LV indicates left ventricle; and RV, right ventricle.

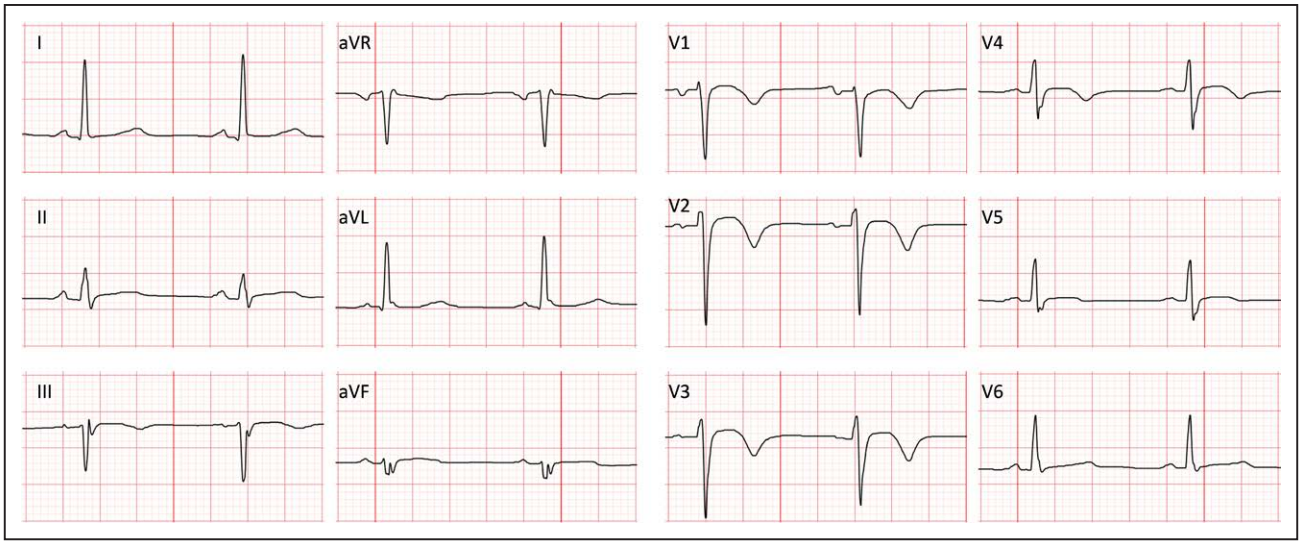


**Figure 4. The 12-lead ECG 7 days after the acute event.**
Twelve-lead ECG 7 days after the acute event revealed T wave inversion from V1 to V4.

of this entity differs from all other types of infarct. This case is of interest because of the ECG features, with predominant ST-segment–elevation in V1 and V2 mimicking an anterior infarction, with a pseudo-Brugada morphology, and without presenting as much elevation in the inferior leads. Similar findings have been previously described,[3] and therefore we propose this ECG pattern as a new way to suspect isolated right ventricular myocardial infarction due to a nondominant right coronary artery. When faced with this ECG, a right-sided ECG would be recommended, especially leads v3R and v4R to rule out or confirm the diagnosis.

## ARTICLE INFORMATION

### Correspondence

Belén Arroyo Rivera, MD, Department of Cardiology, IIS-Fundación Jiménez Díaz, Avenida Reyes Católicos 2, 28040 Madrid, Spain. E-mail belen.arroyo.rivera@gmail.com

### Affiliation

Department of Cardiology, IIS-Fundación Jiménez Díaz, Madrid, Spain (B.A.R.,A.A., P.S.-B., M.O., J.T.). Autónoma University, Madrid, Spain (A.A., J.T.). Vascular Research Laboratory, IIS-Fundación Jiménez Díaz, Madrid, Spain (J.T.).

### Acknowledgments

We acknowledge Oliver Shaw (IIS-FJD, Madrid, Spain) for his assistance in editing this work.

### Disclosures

None.

## REFERENCES

1. Wagner GS, Macfarlane P, Wellens H, Josephson M, Gorgels A, Mirvis DM, Pahlm O, Surawicz B, Kligfield P, Childers R, Gettes LS, Bailey JJ, Deal BJ, Gorgels A, Hancock EW, Kors JA, Mason JW, Okin P, Rautaharju PM, van Herpen G; American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; American College of Cardiology Foundation; Heart Rhythm Society. AHA/ACCF/HRS recommendations for the standardization and interpretation of the electrocardiogram: part VI: acute ischemia/infarction: a scientific statement from the American Heart Association Electrocardiography and Arrhythmias Committee, Council on Clinical Cardiology; the American College of Cardiology Foundation; and the Heart Rhythm Society. Endorsed by the International Society for Computerized Electrocardiology. *J Am Coll Cardiol*. 2009;53:1003–1011. doi: 10.1016/j.jacc.2008.12.016.
2. Bayés de Luna A, Brugada J, Baranchuk A, Borggrefe M, Breithardt G, Goldwasser D, Lambiase P, Riera AP, Garcia-Niebla J, Pastore C, Oreto G, McKenna W, Zareba W, Brugada R, Brugada P. Current electrocardiographic criteria for diagnosis of Brugada pattern: a consensus report. *J Electrocardiol*. 2012;45:433–42.
3. Finn AV, Antman EM. Images in clinical medicine. Isolated right ventricular infarction. *N Engl J Med*. 2003;349:1636. doi: 10.1056/NEJMicm030315.

# Cardiac Arrest With ST-Segment–Elevation in V1 and V2: Differential Diagnosis

Belén Arroyo Rivera, Álvaro Aceña, Pepa Sánchez-Borque, Miguel Orejas and Jose Tuñón

*Circulation.* 2018;137:1742-1744
doi: 10.1161/CIRCULATIONAHA.118.033778
*Circulation* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539